

RPC Development in Beijing and Potential for NO ν A

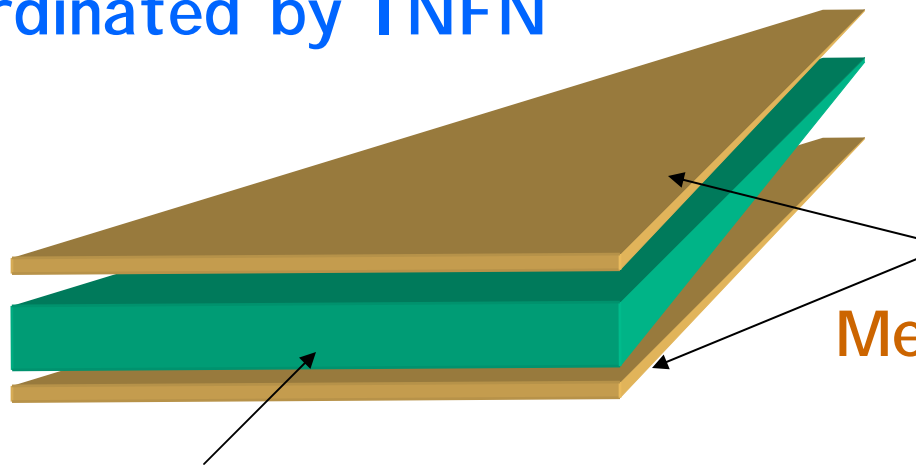
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Standard Bakelite High Pressure Laminate

- Produced in Italy
- Coordinated by INFN

Laminated by hot
steel plates



SURFACE

Melaminic phenolic resin
with fine paper

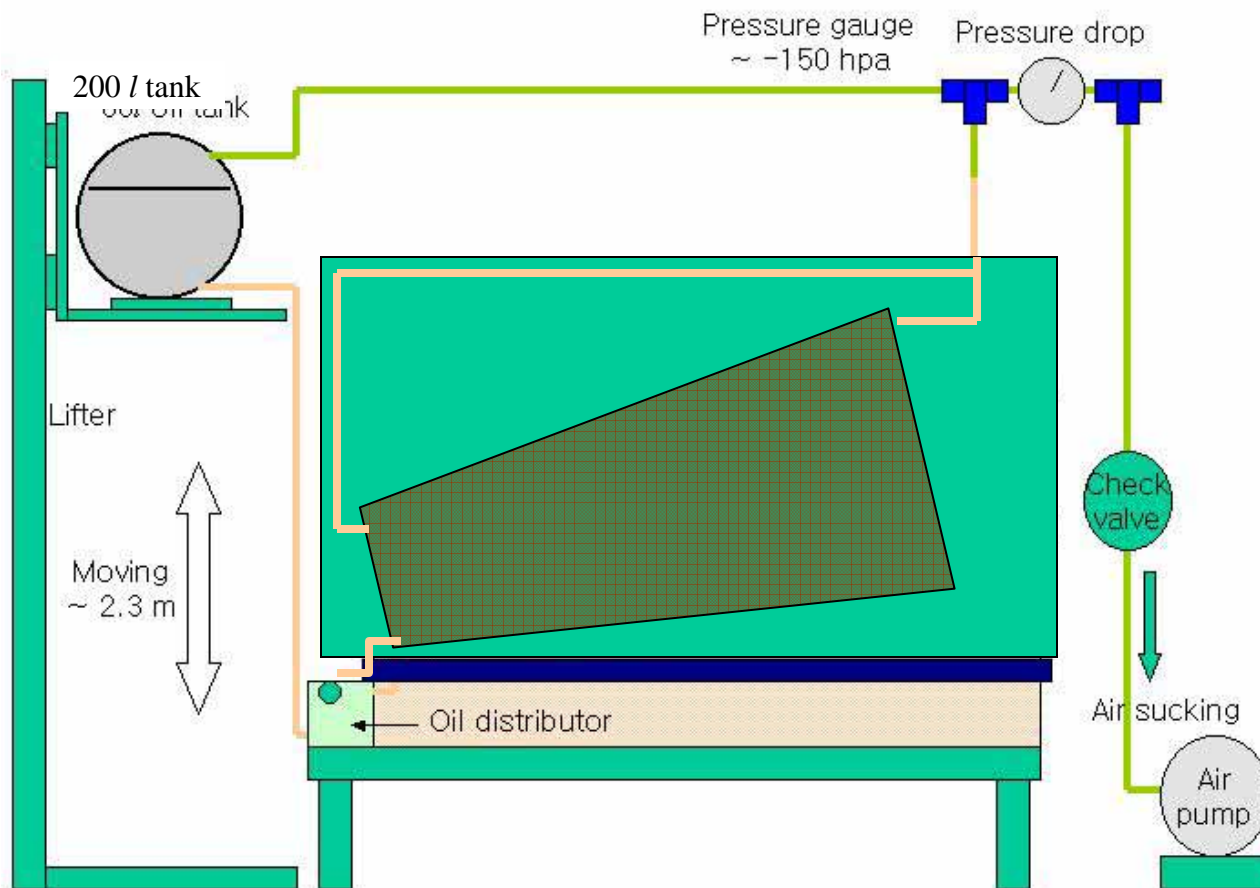
BULK

Phenolic/melamine resin with
regular compressed paper

M. Abbrescia et al., “Test on the Performance of Resistive Plate Chambers in View of Their Use at the LHC,” International Conference on High Energy Physics of the European Physical Society, Jerusalem, Israel, August, 1997.

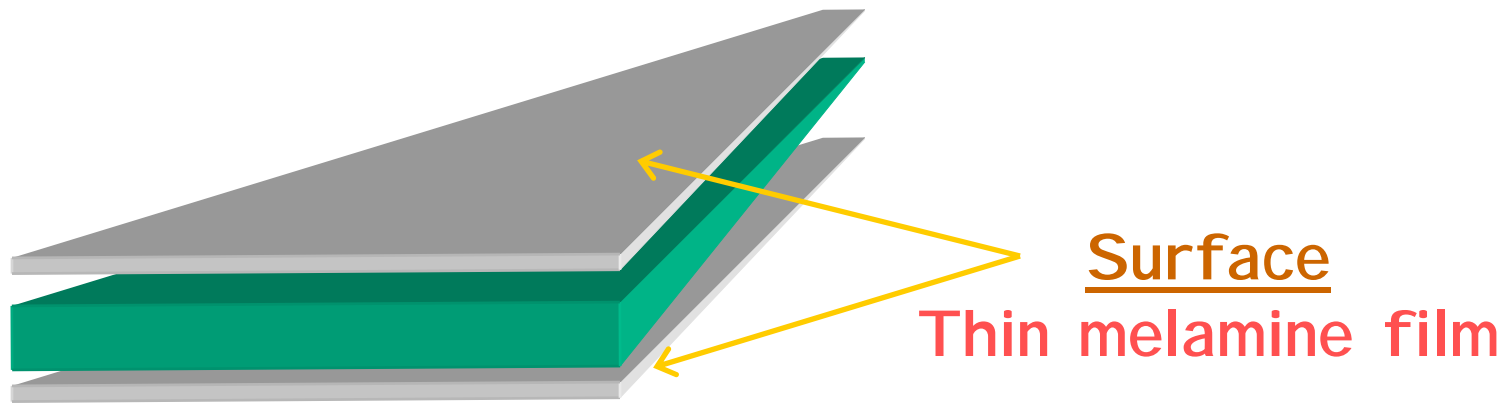
Oiling Procedure for CMS End-cap RPCs

- Linseed oil : Haptane = 40 % : 60 %
- Oil coating at $T = 30 \sim 32^\circ$
- Drying the coated oil with air for 48 hours



Inventions Made at IHEP, Beijing

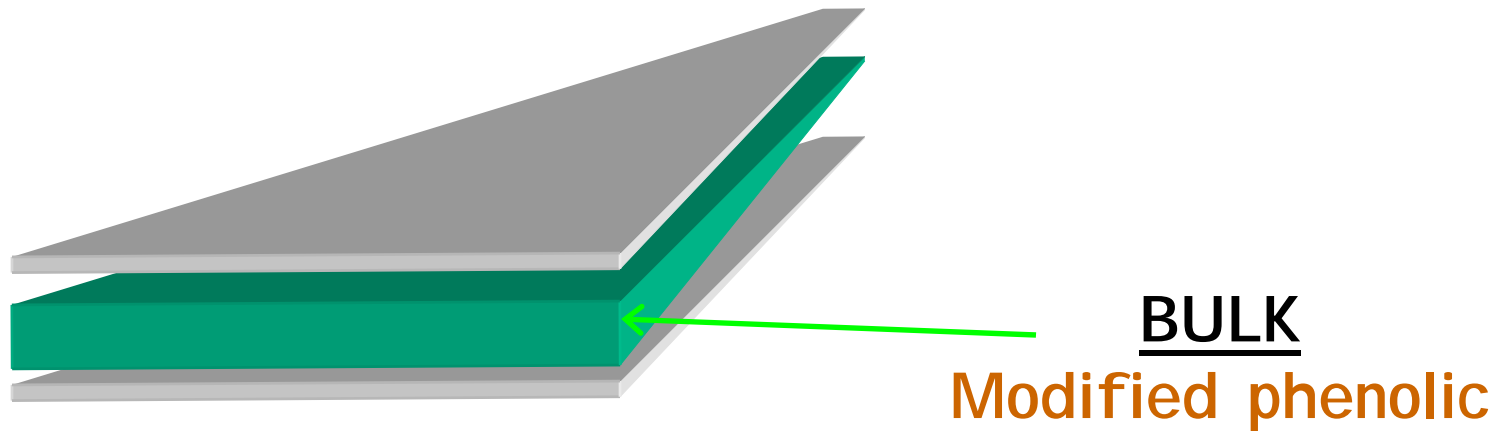
(A) Pre-fabricated melamine film
hot pressed on surface



Much better surface quality than surfaces formed by fine paper and resin pressed by steel plates.

A very simple technical improvement with a dramatic effect on the RPC performance

(B): A special process of modifying the phenolic polymer to obtain the desired bulk resistivity

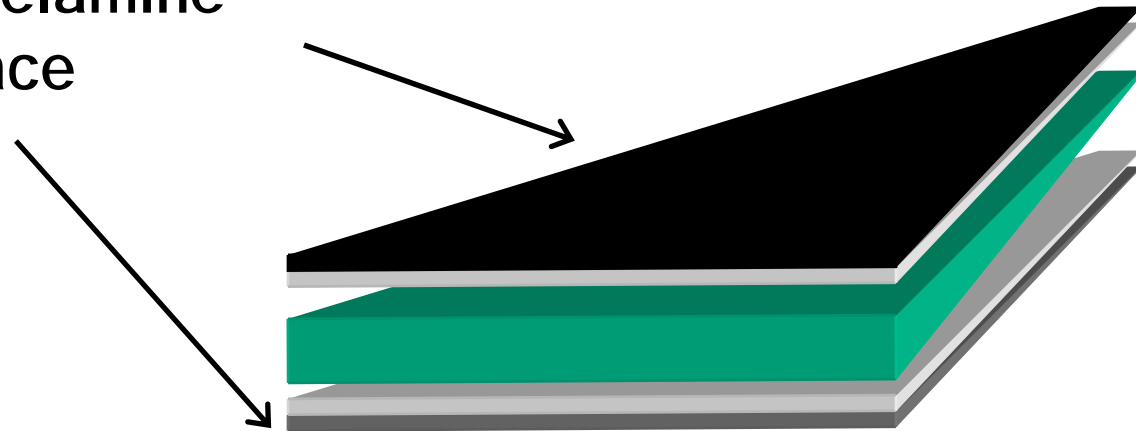


- High resistivity: Low dark current, low noise
-> low rate capability
- Low resistivity: High dark current, high noise
-> high rate capability

(C) Graphite Painting

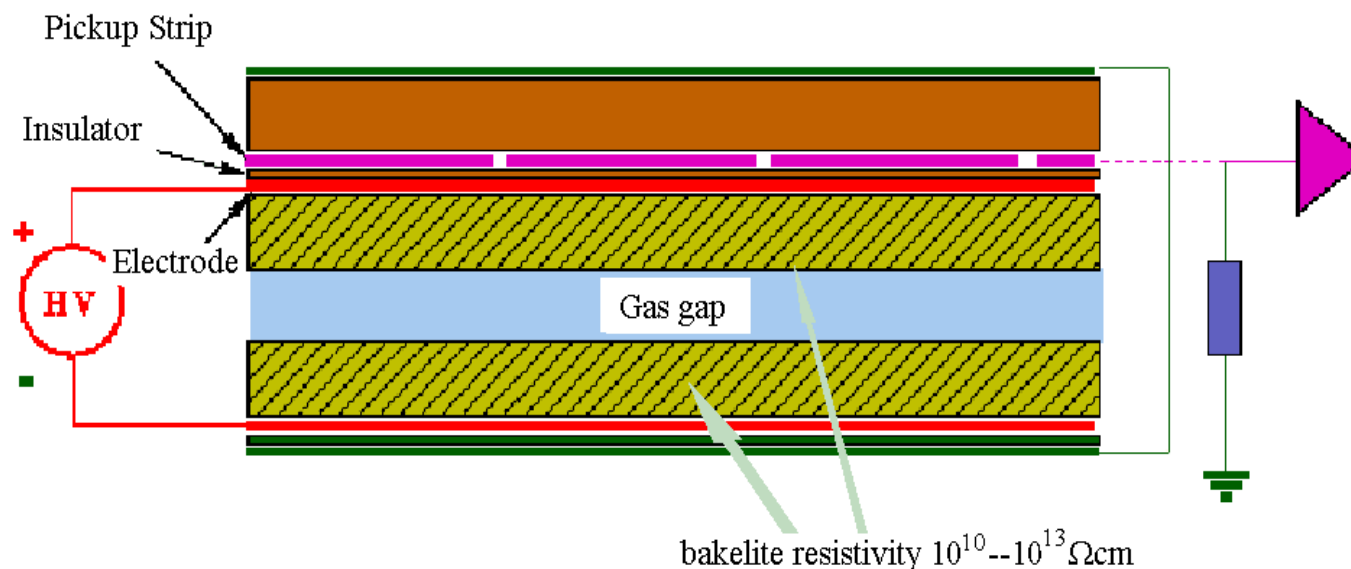
H.V. Electrodes

Special Graphite Paint
for the melamine
surface



- A special graphite paint compatible to melamine film was developed together with Chinese industry.
- Graphite layers is spray painted

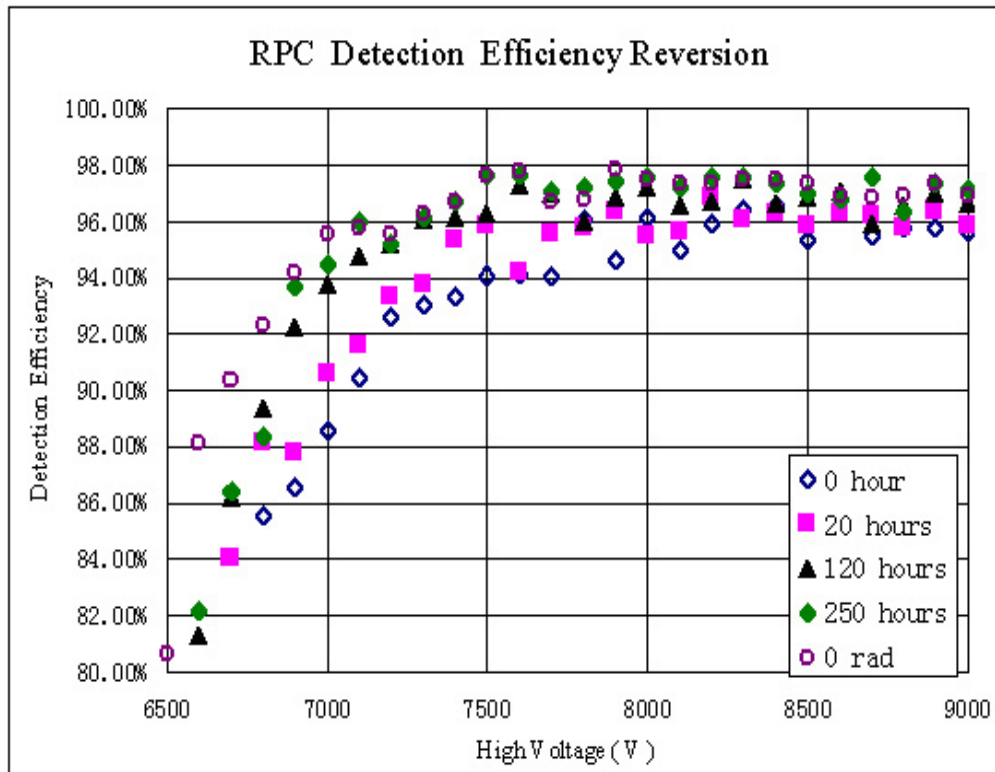
RPC Prototypes



- R&D started four years ago
- Prototypes mostly a single gap, 0.6 m²
- Various plate resistivity: 10^{11} to $4 \times 10^{12} \Omega\text{cm}$
- Streamer mode intended for low rate
- Performance improves as they learn

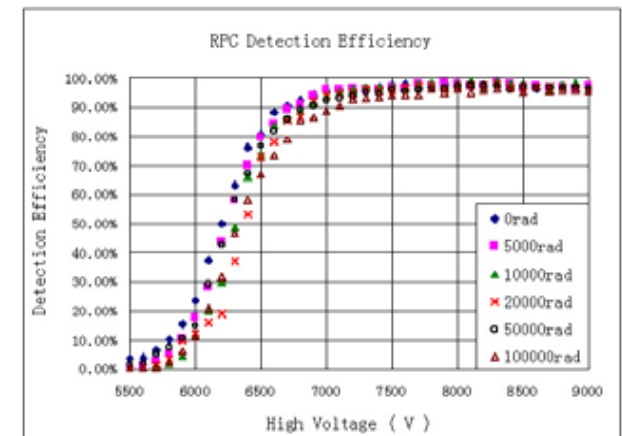
Prototype Performance

Best results are from a recent neutron radiation test

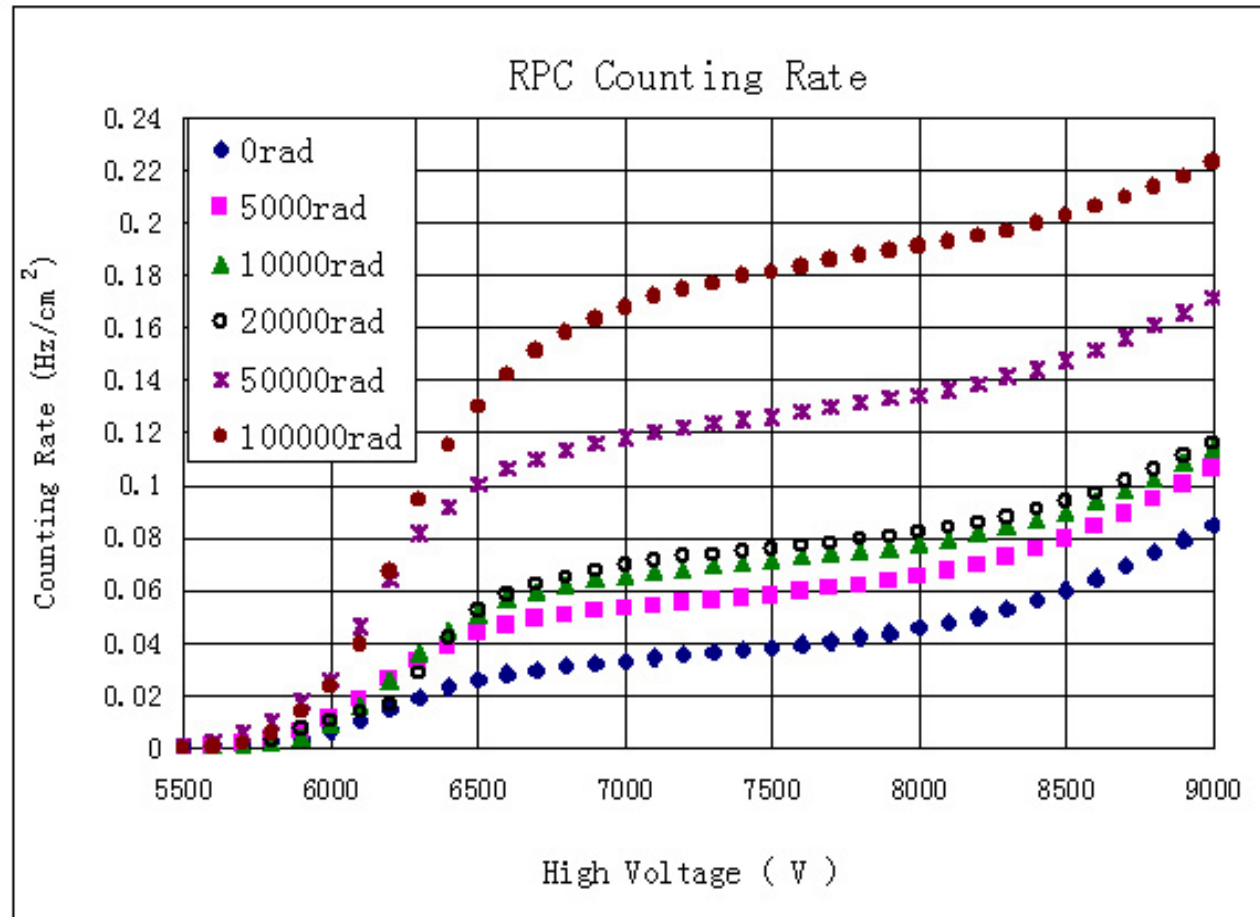


- Long plateau: ~ 2000 V
- High efficiency
96-98% for a single 2 mm gap

- Electrode resistivity: $\sim 10^{12} \Omega\text{cm}$
- Ar/Freon134/Isobutane 32:60:8 (Belle gas)
- Discrimination threshold: 100 mV

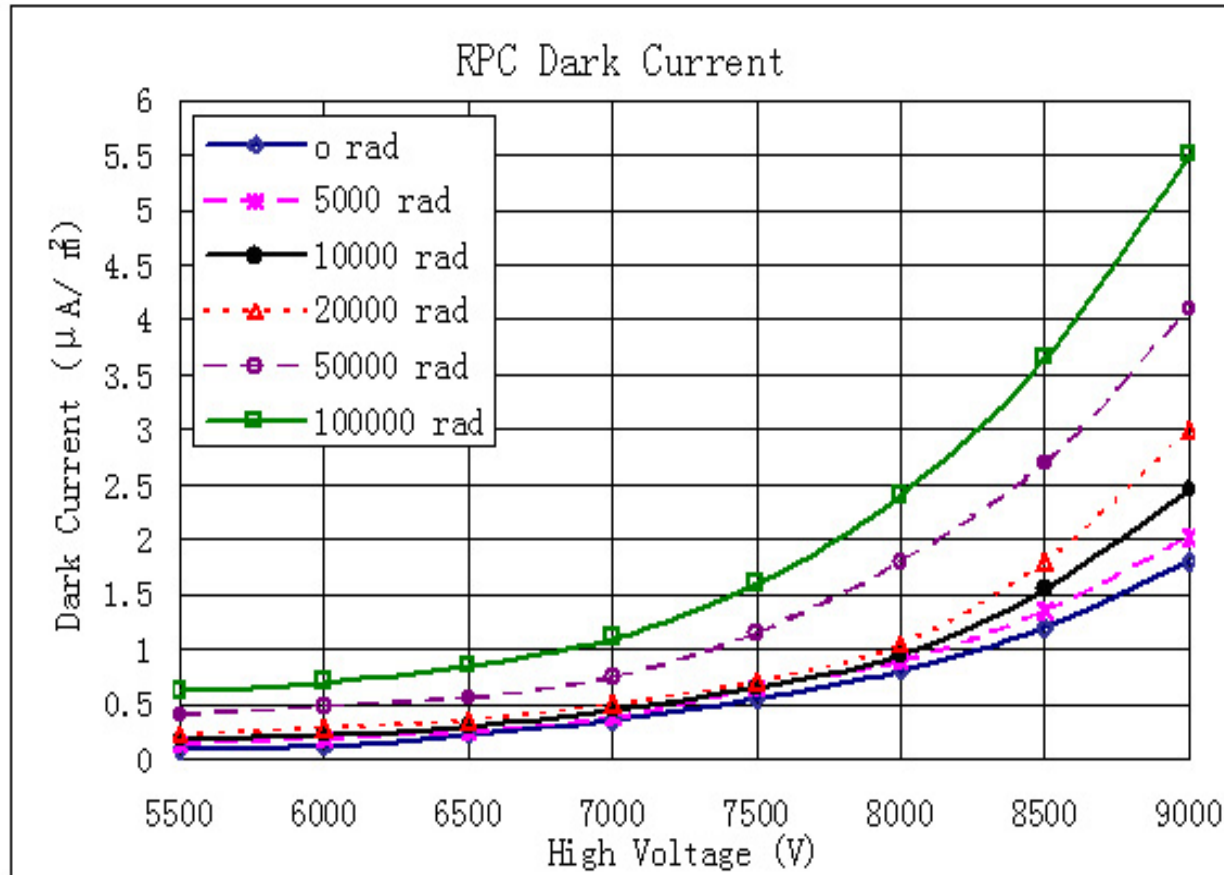


Cosmic Ray Counting Rate



- Noise rate: $0.04 \text{ Hz}/\text{cm}^2$ at 7.5 kV
- At the cosmic ray rate level (**cosmic: $\sim 0.03 \text{ Hz}/\text{cm}^2$**)
- Comparable performance as best oiled bakelite or glass RPCs

Dark Current



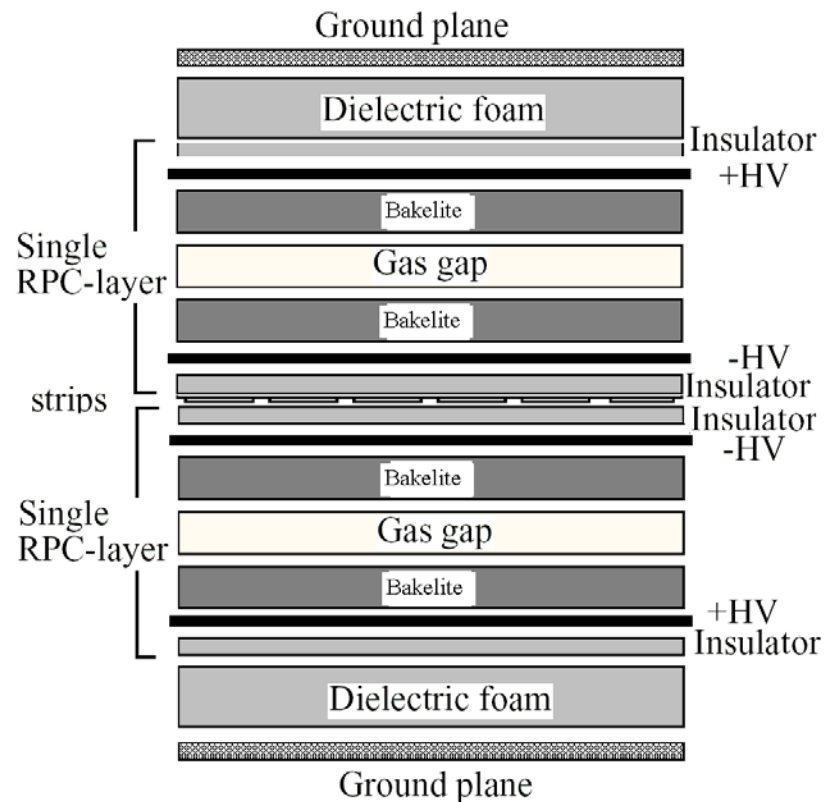
- ~0.5 μA @7.5 kV
- No break down up to 9000 V

Status of BESIII RPCs

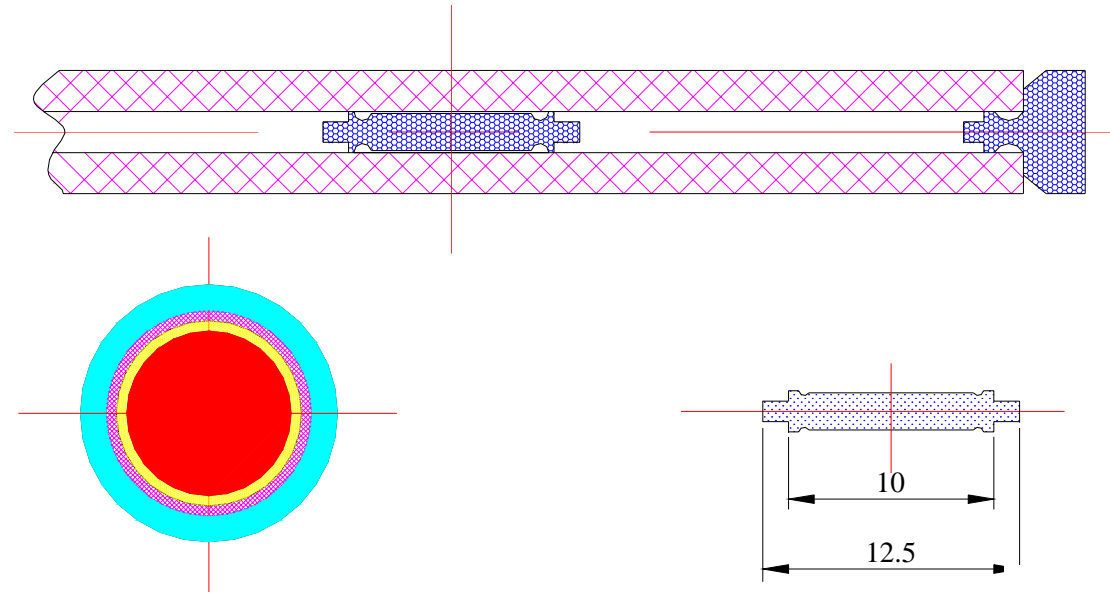
- Prototypes show the performance is as good as chambers made from oiled bakelite or glass
- A factory was setup in the south suburb of Beijing
- Pre-production started early 2004
- Just has an internal production readiness review
- Making 2000 m² RPCs in 2 years

Technical Details of BESIII RPC

- Standard double gap structure
- Single layer of pick up strips
- Bulk Resistivity: 2×10^{11} to $2 \times 10^{12} \Omega\text{cm}$

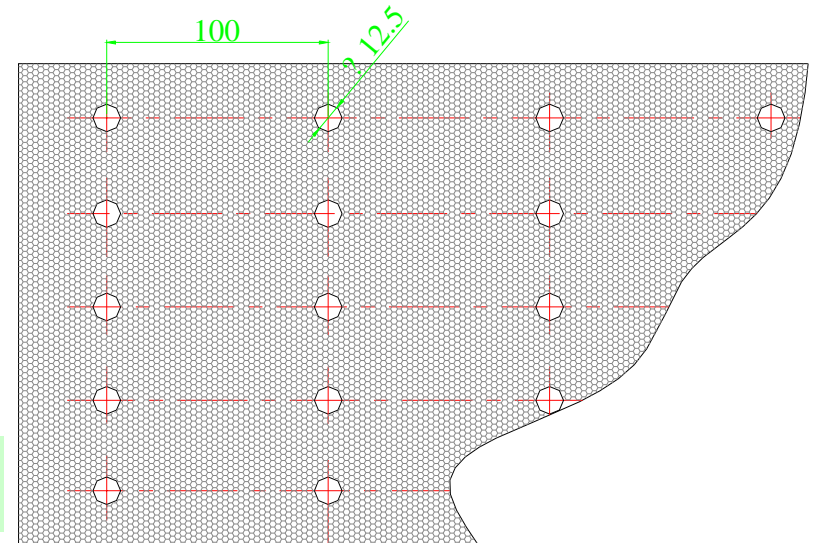


Technical Details



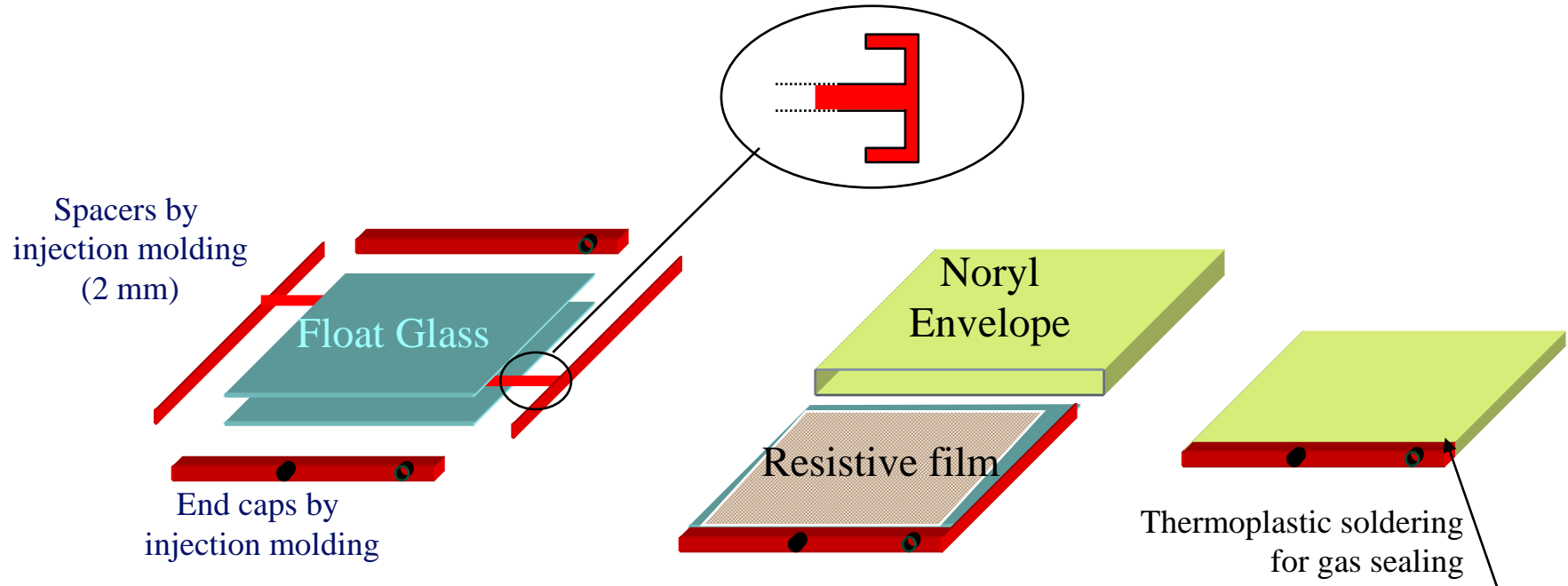
Gap Structure

Spacer Arrangement



Compare to Low Cost Glass RPCs Developed by Monolith

- Bakelite does not break
- Lower resistivity, bigger signal, slightly higher efficiency
- Bakelite RPC does not need a plastic envelop



Potential for NO_vA

- The factory in Beijing can make RPCs with maximum size 4'x8' (5'x10' in Europe)
 - Limited by their lamination press
 - Should be large enough for NO_vA
- They will be very happy to make a few for NO_vA

Plan

First Step: Make several RPCs in Beijing and bring them back to U.S. for testing

Single gap

Double gap with three bakelite plates

Second Step:

Make several 4'x8' chambers with the gap configuration we like

With readout electrodes and ground plane on particle board